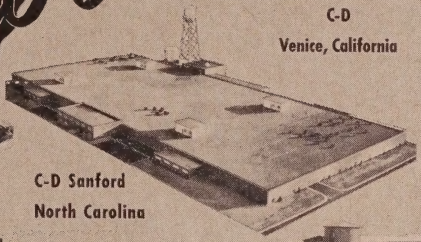
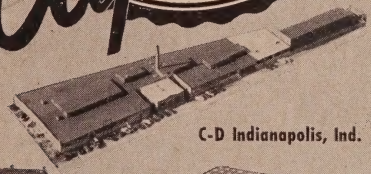
the CORNELL-DUBILIER Capacitor

Subsidiary
The Radiart Corp.
Cleveland, Ohio

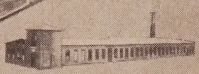
C-D
Venice, California



C-D Sanford
North Carolina



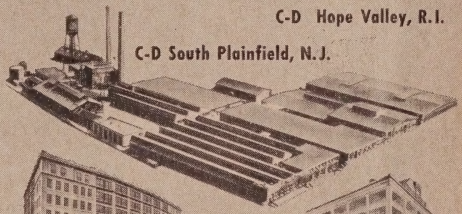
C-D Indianapolis, Ind.



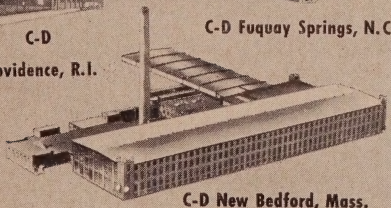
C-D Hope Valley, R.I.

C-D
Providence, R.I.

C-D Fuquay Springs, N.C.



C-D South Plainfield, N.J.



C-D New Bedford, Mass.

C-D Worcester, Mass.

C-D Cambridge, Mass.

Vol. 24 JULY - AUGUST 1959 No. 4

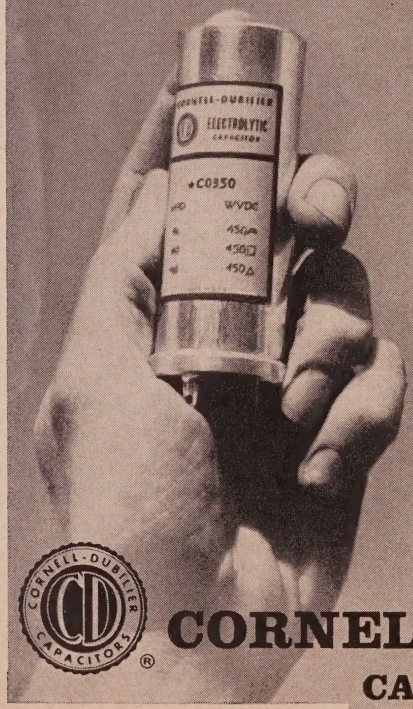
CORNELL-DUBILIER ELECTRIC CORP.
Hamilton Boulevard, South Plainfield, N. J.

POSTMASTER: If undeliverable for any reason, notify stating reason, on Form 3547 postage for which is guaranteed.

Sec. 34.66 P.L.&R.
U. S. POSTAGE
PAID
So. Plainfield, N. J.
Permit No. 1

MR. W. E. HILLIARD
PENN ALLEN RADIO SHOP
438 ALLEN ST.
ALLENTOWN, PA.

to do the best job use the best*



*C-D twist-prong electrolytics, for instance . . . and, to be always ready for the job, stock C-D "Preferred" Twist-Prongs (marked with a★).

CORNELL-DUBILIER

CAPACITORS

Old Hands at Dependability

★ look for the star on the label.

Copyright, 1959. Cornell-Dubilier Electric Corporation.

SURVEY OF SOLID-STATE DEVICES

Much of the noteworthy electronic progress during the past twenty years has been made in the area of solid-state research. This work started so quietly as to attract little attention but snowballed rapidly and has produced many of the glamour components of electronics.

Progress in solid-state research and development has resulted from increased understanding of the behavior of certain solid materials, notably semiconductors, in electric circuits. The materials employed in some solid-state devices are true semiconductors. Examples of such devices are diodes, transistors, rectifiers, and photocells. Materials used in other solid-state devices are not semiconductors. Examples of the latter devices are non-linear resistors, non-linear capacitors, ferroelectric cells, electro-luminescent cells, and Hall-effect devices.

Solid-state components are applied widely in modern electronics for a variety of functions including rectification, amplification, control, modification of currents or voltages, frequency conversion, harmonic generation, conversion of light into electricity, production of light, and production of d-c voltage. In most instances, solid-state devices are simpler than other components which will perform the same functions, and in some instances they are miniature as well.

As a simple survey of the art, this article purposes to show the scope of solid-state applications and to direct attention to individual components, their operating principles, and present state of development. A bibliography is presented for more detailed reference.

Diodes

Diodes are made from specially-processed semiconductor materials. The diode essentially is a small rectifier which is applied to radio and television detection, light-duty rectification (as in low-current power supplies, meter circuits, d-c relay operation from ac, etc.), signal conversion, d-c restoration, modulation, demodulation, harmonic generation, and switching and clamping in computers. There are, of course, many other uses.

The principal semiconductor materials employed in high-frequency diodes are germanium and silicon. The material is doped with an impurity material to render it either N-type (conducting principally by means of electrons) or P-type (conducting principally by means of holes). In the manufacture of a diode, a junction is suitably formed between an N-type and P-type layer of the same semiconductor. Commercial diodes are available in two types of fabrication: junction and point-contact. However, the latter is essentially a junction-type unit also, since in its manufacture a heavy current pulse electroforms a region of opposite type (P or N) directly under the point of contact between the whisker and semiconductor. Because current will flow more readily in one direction through the junction of a diode than in the opposite direction, rectification is made possible.

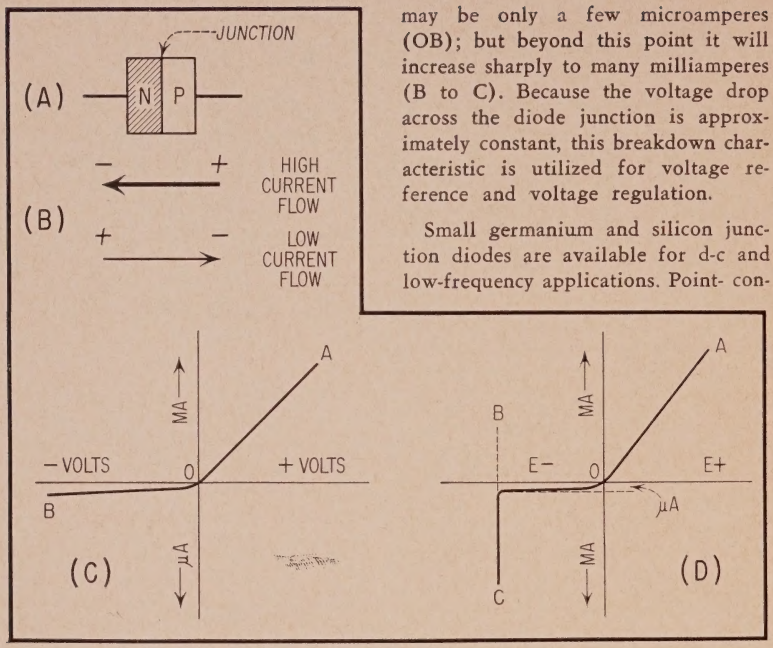


Fig. 1. Diode and Rectifier Characteristics.

Figure 1 illustrates the principal characteristics of the semiconductor diode. Figure 1(A) shows the basic arrangement of the junction structure. Maximum (forward) current flows when the P-layer is biased positive with respect to the N-layer (See Figure 1B). Minimum (reverse) current flows when the P-layer is negative. The plot in Figure 1(C) illustrates this assymetrical flow: Forward current flows from O to A, and reverse current from O to B.

Zener diodes are processed to exhibit a sharp breakdown (BC) when reverse-biased, as shown in Figure 1(D). Up to a predetermined value of reverse voltage, the reverse current may be only a few microamperes (OB); but beyond this point it will increase sharply to many milliamperes (B to C). Because the voltage drop across the diode junction is approximately constant, this breakdown characteristic is utilized for voltage reference and voltage regulation.

Small germanium and silicon junction diodes are available for d-c and low-frequency applications. Point-contact silicon diodes are usable up to several thousand megacycles. The maximum operating temperature for germanium is approximately 50°C, while that of silicon diodes is 200°C. The largest single application for diodes presently is in the digital computer where several thousand may be employed for switching, logic, clamping, and other purposes.

Selenium diodes have a somewhat different construction and, mainly because of their higher internal capacitance, are limited in use to frequencies lower than 50 kc.

Rectifiers

The principal use of semiconductor rectifiers is the conversion of ac to dc

at useful power levels. Commercial types include copper oxide, magnesium-copper sulphide, selenium, germanium, and silicon. In some applications, germanium and silicon rapidly are superseding the other three types. Copper oxide rectifiers have been replaced almost entirely at high power levels by the other types which offer superior performance.

In the first three types, rectification is afforded by the junction between a crystalline semiconductor material (copper oxide, copper sulphide, or selenium) and a metal base plate (copper, magnesium, or aluminum, respectively) upon which it is spread or deposited in a layer. The maximum permissible current through the rectifier is a function of the junction area, and the maximum permissible voltage drop a function of the junction thickness. For increased voltage-handling ability, several rectifier plates usually are assembled in series in a "stack."

Plate-type selenium rectifiers cover the tremendous current range of more than 1 million to 1, their practical application extending all the way from small radio-type units (delivering a few milliamperes output current) to large power rectifiers delivering several thousand amperes output. The high internal capacitance of the selenium rectifier limits its efficient use to power frequencies.

Modern germanium and silicon power rectifiers may be regarded as "grown-up" diodes with the same essential junction arrangement as that shown in Figure 1(A). Advantages of these rectifiers over other types are smaller size, low internal capacitance (therefore higher-frequency operation), simpler mechanics, higher efficiency (up to 99%), higher applied and peak inverse voltages per rectifier cell, and in some instances better economy. Operation of germanium power rectifiers is limited to maximum ambient temperatures of approximately 65°C, without derating. Comparable silicon power rectifiers may be operated up to 200°C before derating.

Rectifiers processed to show a sharp current increase ("breakdown") at a predetermined reverse voltage serve as power-type Zener diodes.

Transistors

The transistor is a semiconductor device with two junctions (See Figure 2A). Going one step further than the diode, this device affords amplification and control, often at high gain ratios. Either N-type or P-type germanium or silicon may be employed as the semiconductor in a transistor, as in a diode. Layers of the opposite type are suitably processed into the material to produce either an NPN or PNP sandwich, the center layer (or **base**) standing in a circuit in a manner similar to the grid of a vacuum tube. One of the outside layers is termed **emitter**, since it serves to inject current carriers (electrons in the NPN unit, or holes in the PNP unit) into the base region; and the other outside layer is termed **collector** because (like the plate of a tube) it collects the carriers.

Figure 2(B) shows the basic common-emitter circuit for a PNP transistor. Base current i_b is supplied by Battery V_{BB}; collector current i_c by Battery V_{CC}. Because the base voltage is low, i_b is much smaller than i_c, although the base-emitter junction is

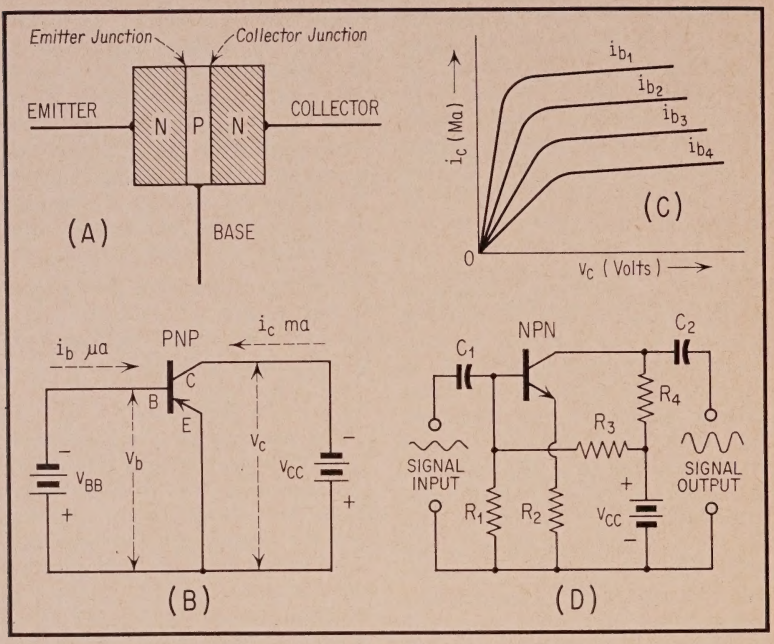


Fig. 2. Transistor Characteristics.

forward-biased and the collector-emitter junction is reverse-biased. Thus, the base-emitter (input) impedance is much lower than the collector-emitter (output) impedance. A small change of base current (di_b) produces a much larger change (di_c) in collector current. Thus, the ratio di_c/di_b expresses the current amplification (gain) of the transistor. Figure 2(C) illustrates operation of the transistor. These plots are seen to resemble the typical family of characteristic curves for a pentode tube.

Figure 2(D) shows a typical RC-coupled a-f amplifier stage employing an NPN transistor. Here, positive base bias is supplied from the collector battery, V_{CC}, through the voltage divider, R_1-R_3. Resistor R_2 is an emitter current-limiting resistor comparable to the cathode resistor in a tube circuit.

Commercial, small-signal transistors presently are available in a wide variety of types adaptable to many amplifier, oscillator, and control applications. While only the triode type is shown in Figure 2, tetrodes also are available. The maximum operating frequency of commercial small-signal types is approximately 100 Mc for triodes and 200 Mc for tetrodes. (Oscillation is obtainable up to 600 Mc in some types). Newly-developed commercial triodes have cutoff frequencies up to 750 Mc. Experimental transistors have been operated at much higher frequencies in the laboratory. The maximum permissible small-sig-

nal power dissipation is approximately 200 milliwatts. The maximum operating temperature for germanium transistors is approximately 85°C; the maximum for silicon transistors is 150°C.

Power transistors have essentially the same basic arrangement as small-signal units (Figure 2A) but their junctions have been designed for higher power dissipation. Typical medium-power transistors have maximum dissipation ratings up to approximately 1 watt and collector current ratings up to approximately 60 ma. Depending upon type, commercial high-power transistors have maximum power dissipation ratings up to 50 watts, collector current up to 20 amperes, and collector voltage up to 120 v. Because of increased junction capacitance and other factors, power transistor operation presently is limited to audio frequencies.

Lately, a new power-transistor-type semiconductor device, the controlled **rectifier,** has appeared. This unit is capable of handling large amounts of power and behaves in a manner similar to the thyratron tube.

Non-Linear Resistors

A special type of 2-terminal solid-state device is the non-linear resistor. This component is employed wherever a non-ohmic variation of current (against a linear variation of applied voltage) is desired.

In direct-current circuits, a semiconductor diode could function as a non-linear resistor, since its current does not vary linearly with voltage. (See Figures 1C and 1D). However, the rectifying properties of the diode restrict its resistor applications mainly to dc.

Other types of non-linear resistor are available, however, and these ex-

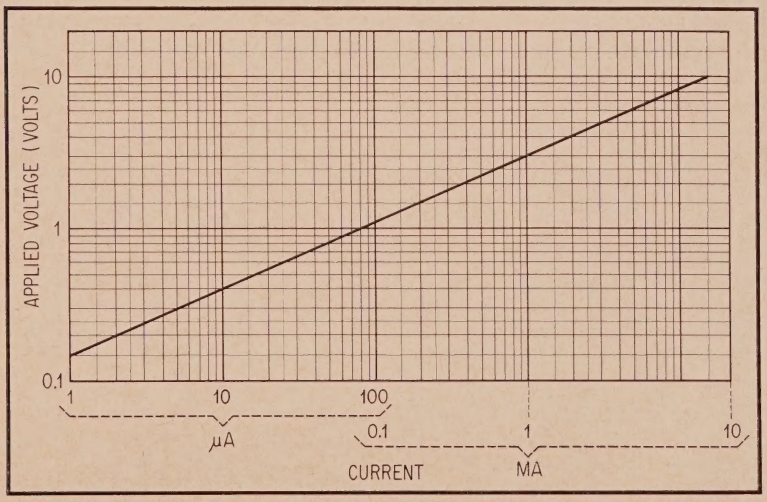


Fig.3. Characteristics of Non-Linear Resistor.

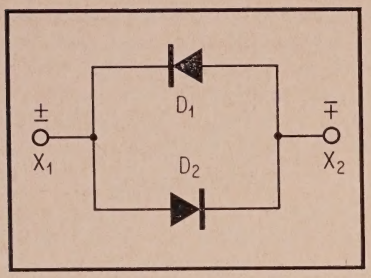


Fig. 4. Dual-Diode Non-Linear Resistor.

hibit no rectifying properties. One such resistor is the Thyrite type. In Thyrite, the current varies as a power of the applied voltage (a-c or d-c), that power depending upon the predetermined constitution of the material. Thyrite resistors are commercially available in a number of sizes and shapes and for use at various power levels. Thyrite resistors are made from silicon carbide.

Figure 3 shows the approximate current-voltage relationship for one type of Thyrite resistor. This plot has been made for a voltage variation from 0.1 to 10 v and a corresponding current variation from 1 microampere to 20 milliamperes. Note that the current changes in value more than 100 to 1 (from 1 μa to 100 μa) in response to a voltage variation of 10 to 1 (from 0.1 v to 1 v).

Figure 4 shows the connection of two semiconductor diodes to form a non-linear resistor suitable for limited use on ac. When Terminal X_1 is positive, Diode D_2 conducts forward current; and when X_2 is positive, D_1 conducts. In this way, both halves of the a-c cycle are accommodated. By using high-back-resistance diodes, current during the reverse half-cycle is minimized.

Since for a linear voltage rise, the rate of current rise through a non-linear resistor is somewhat greater than linear (Figure 3), the current waveform will be distorted when compared with the voltage waveform. The current through a non-linear resistor accordingly is rich in harmonics, especially odd-numbered ones. Figure 5 shows the non-linear IE characteristic curve for a Thyrite resistor. Its shape readily accounts for the distortion of an applied ac.

Non-linear resistors are employed for voltage regulation, current-rate multiplication, harmonic generation, oscillator stabilization, amplitude limiting, and surge suppression (especially lightning arresting).

The **thermistor** also is a solid-state non-linear resistor. It may be employed in some circuits in which Thyrite or other non-linear resistors usually are operated, since it works on either ac or dc. However, the main useful property of the thermistor is the sensitivity of its resistance to temperature. This component is widely used as a temperature sensor or as a bolometer

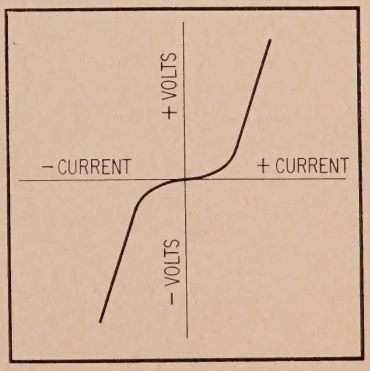


Fig. 5. Conduction Characteristic of Non-Linear Resistor.

in such instruments as temperature bridges, pyrometers, microwave power meters, etc. Thermistors are made from suitable oxides.

Because of the sensitivity of the thermistor to its own internal temperature, as well as to ambients, its resistance (which decreases with increasing temperature) and the resulting current it passes may not reach a final value until some instant after a voltage has been applied. This time delay is utilized in such circuit applications as contactless time-delay switching, or in imparting a delay interval (set by proportioning circuit resistances) to some other component with which it is connected in series.

Photocells

Solid-state photocells are of two types: **self - generating** (photovoltaic) and **photoconductive.** The self-generating type produces a d-c voltage directly as the result of its being illuminated. The photoconductive type undergoes a decrease in resistance when illuminated. The principal types of self-generating cells are selenium and silicon. The earlier copper-oxide photovoltaic cell has been supplanted largely by these two types. Photoconductive cells include cadmium sulphide, cadmium selenide, lead sulphide, and germanium photodiode types. The action of both self-generating and photoconductive cells results from the release of current carriers in the solid material by light energy.

Figure 6 illustrates the basic comparison of the two types. The self-generating cell is indicated in Figure 6(A). It delivers a d-c voltage which may be employed directly to actuate a microammeter or sensitive relay or to drive a d-c amplifer. The photoconductive cell in Figure 6(B) is connected in series with a battery and the load device (R_L) which is to be operated. The dark resistance of the cell is so high that virtually all of the battery voltage appears across the cell, and little or none across the load. Under illumination, the cell resistance falls to a very low value and the maximum voltage appears across the load.

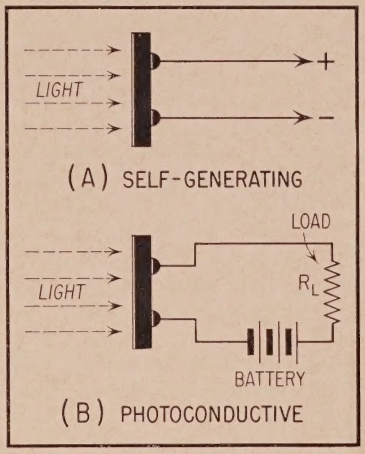


Fig. 6. Basic Photocell Comparison.

Depending upon size, type, light intensity, and load resistance, commercial selenium self-generating photocells deliver outputs up to 35 ma per square inch of exposed cell surface. Silicon photocells deliver up to 200 ma per square inch. The spectral response of the silicon cell peaks around a wavelength of 800 millimicrons; that of the selenium cell around 550 millimicrons.

Modern, miniature photoconductive cells of the cadmium selenide and cadmium sulphide types can withstand

powerline a-c or d-c voltage levels and hence are capable of operating relays and other devices without amplification. Typical sensitivity provided by cells of these types is 100 to 600 microamperes output at 100 volts under illumination of 2 foot-candles.

The germanium photodiode is a photoconductive cell similar in construction to a semiconductor diode. In operation, this unit is reverse-biased by a maximum of 50 volts. The dark current is of the order of 10 μa, and the maximum current at 3000 lumens per square foot, 600 μa. The spectral response peaks in the infra-red region. The frequency response of the germanium photodiode permits operation up to 20 kc at approximately 65% of its 1-kc efficiency.

Still another solid-state light-sensitive device is the **phototransistor.** This is a 3-layer junction device similar to the small-signal transistor. Here, however, the current carriers are released by light energy rather than by an electrical signal input. A collector voltage is applied. The current amplification of the transistor structure thus is available, and this results in greater sensitivity than is afforded by the simpler photodiode.

Non-Linear Ceramic Capacitor

Capacitance is sensitive to applied voltage in a special 2-plate capacitor fabricated from high-Q solid dielectric material such as barium titanate. When such a capacitor is connected in series with an a-c source and a load, and the reactance of the capacitor is varied by means of a lower-frequency signal voltage, the a-c voltage appearing across the load will be proportional to the signal voltage. By properly choosing the circuit constants and source ("pump") frequency, amplification of the signal will be obtained. This is the principle of the dielectric amplifier.

The dielectric amplifier has the advantages of simplicity, relatively high frequency response, and high input impedance. Its principal disadvantages are the requirement of a high-frequency power supply and the temperature sensitivity of the dielectric.

Non-linear capacitors have been employed, in addition to amplification, for frequency multiplication, oscillation, frequency modulation, and remote tuning.

Semiconductor-Junction Capacitor

Operating similar to the non-linear ceramic capacitor is the semiconductor-junction capacitor. This is a specially-processed silicon junction, the capacitance of which varies with an applied reverse d-c bias voltage (upon which may be superimposed an a-c signal voltage). Like the ceramic unit, the voltage-variable diode capacitor has been employed for amplification, frequency modulation, automatic frequency control, frequency multiplication, remote tuning, and control operations. The desirable high-temperature operating characteristics of the silicon diode are available in the diode-capacitor, which gives the latter an advantage over the temperature-sensitive ceramic unit.

Commercial diode-capacitors are available in nominal capacitances from 3 to 250 $\mu\mu$fd. Capacitance changes up to 10 to 1 may be obtained by varying a d-c bias voltage. Because the d-c voltage reverse-biases the junction, the current flow is negligible, as low as

0.01 microampere in some instances. Hence, virtually no load is imposed upon the bias and input-signal sources.

Ferroelectric Cell

A ceramic-type non-linear 2-plate capacitor element, somewhat similar to the unit employed for dielectric amplification, exhibits a memory effect since it may be polarized in one direction or the other at will. The steep electrostatic hysteresis loop evidenced by certain single-crystal solids (notably, barium titanate, guanadine aluminum sulphate hexahydrate, and triglycene sulphate) give this property to the ferroelectric cell. Figure 7 shows such a loop.

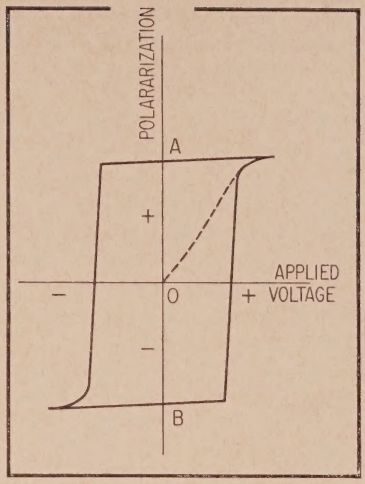


Fig. 7. Hysteresis Loop of Ferroelectric Cell.

Successive voltage pulses will polarize the cell either to Point A or Point B, the cell remaining in one state of polarization until switched to the opposite state by a voltage pulse of opposite polarity. This effect gives promise of use in computer memory circuits, as well as in electrostatic (ferroelectric) flip-flops, shift registers, and similar switching systems.

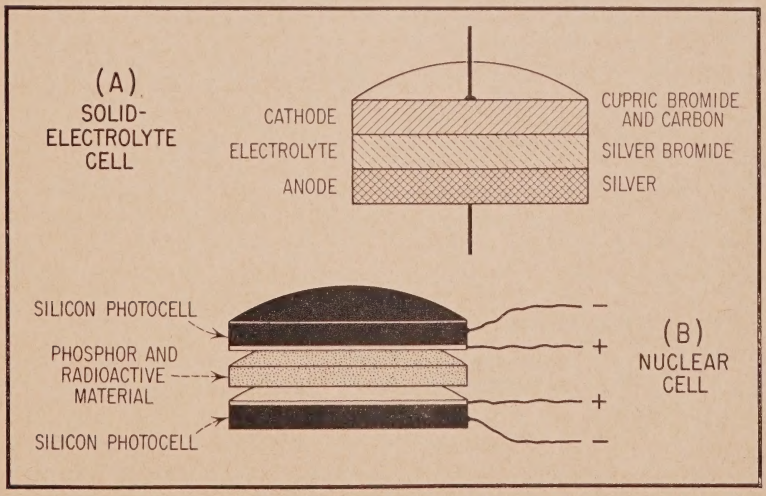


Fig. 8. Solid-State Battery Cells.

In this operation, the ferroelectric cell may be regarded as the dual of the ferrite core, another solid-state component but one which utilizes magnetic hysteresis.

Solid-State Batteries

Solid-state batteries of two types recently have been introduced. One employs a solid dielectric; the other utilizes radioactivity. Cells of both types are shown in Figure 8.

The first type, shown in Figure 8 (A), uses silver bromide as the dry solid dielectric. Cell action results from diffusion of positive silver ions through the solid silver bromide. In true electrochemical cell manner, one electrode material is consumed — in this instance, the silver anode. In its present state of development, this cell is a low-current device. Prelimary cells have delivered terminal voltages of approximately ¾ v. Fabricated as small buttons, they have extremely long storage life, good recovery characteristics, completely dry nature, and can be stacked to produce miniature, high-voltage, low-current batteries.

The second type, illustrated by Figure 8(B), produces d-c voltage by a 2-step action: Exploding atoms in a suitable radioactive material, mixed with a phosphor in the center layer, causes a multitude of light flashes from the phosphor. These, in turn, actuate the silicon photocells which comprise the two outside layers, and these photocells deliver the d-c voltages.

This nuclear cell is tiny, preliminary models being less than dime-sized. These cells deliver low currents (of the order of microamperes). They have extremely long life. The two photocell outputs may be connected in series for potentials between ¼ and 1 volt. A contemporary, commercial nuclear battery delivers 5 kv open circuit and 3 kv at 50 $\mu\mu$a load.

Electroluminescent Cell

The production of light directly from the electrical excitation of a phosphor is accomplished in the **electroluminescent cell** or **panel.** This device is represented simply in Figure 9.

The phosphor layer is sandwiched between two outer glass plates. The inner surface of each glass plate is

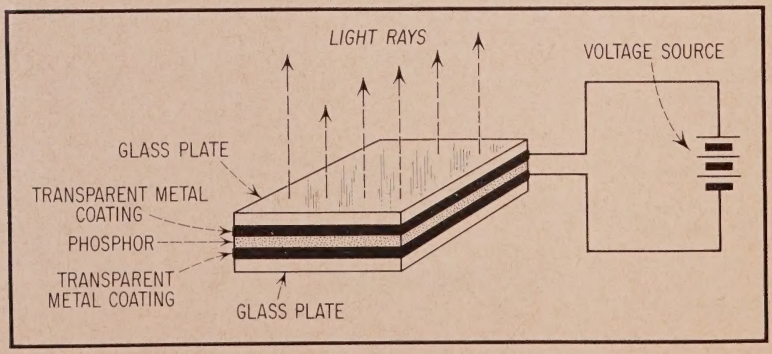


Fig. 9. Electroluminescent Cell.

coated with a transparent metallic film which permits electrical contact with the phosphor surface and at the same time allows light rays to pass through. The two films are connected to a suitable voltage source, usually between 600 v and several kv. Under the influence of the applied emf, the phosphor glows and the resulting light rays are readily transmitted out through the thin films and glass plates.

Combinations of electroluminescent cells and self-generating photocells have been used in several interesting applications such as light amplifiers, switching circuits, and relaxation oscillators.

Hall-Effect Devices

Research in intermetallic compounds, of which indium antimonide is a well-known example, has yielded useful new magnetoresistance components which utilize the Hall effect. This effect is the deflection of conduction electrons

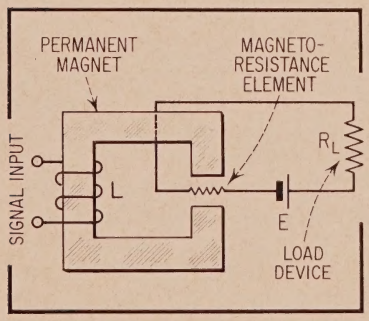


Fig. 10. Galvanomagnetic Amplifier.

in a current-carrying body to the outer edge by a magnetic field applied transverse to the direction of current flow. The net result of the effect is a change in the resistance of the body.

Simple Hall-effect devices have been employed in a gauss-meter probe which delivers a d-c output proportional to the strength of an applied magnetic field, and as magnetosensitive resistors for rectification, current and voltage regulation, chopping, conversion, and various types of control.

Figure 10 shows the basic arrangement of a galvanomagnetic amplifier employing a small indium antimonide magnetoresistance element mounted in the air gap of a permanent magnet. A d-c voltage, E, is applied in series with the element and a load device, R_L. An a-c input-signal voltage applied to the magnet coil, L, modulates the intensity of the magnetic field in the gap, and accordingly varies the resistance of the element. The modulated resistance, in turn, modulates the flow of current from E through R_L. Power gains of the order of 40 db have been reported for single stages of this type, and cascaded stages have been employed in larger amplifiers.

Aside from indium antimonide, some of the other intermetallic compounds which are being used in developmental work include indium arsenide, aluminum antimonide, gallium phosphide, lead selenide, lead telluride, bismuth selenide, and bismuth telluride.

BIBLIOGRAPHY

For more detailed treatments of the application of solid-state materials and devices, the following sources are recommended. Additional references will be found in some of the articles quoted.

C-D CAPACITOR

1. **Transistor Circuits.** February, 1950.
2. **Tubeless Power Supplies.** June, 1950.
3. **Dielectric Amplifiers.** July, 1954.
4. **Special - Purpose Transistor Circuits.** February, 1955.
5. **Modern Photocells.** June, 1955.
6. **Semiconductor Regulated Power Supplies.** March, 1957.
7. **Applications of Silicon Junction Diodes.** May, 1957.
8. **Applications of Power Transistors.** June, 1957.
9. **New Developments in Semiconductor Devices.** August, 1957.
10. **Ferroelectricity and Its Applications.** Sept.-Oct. 1958.

In addition, numerous CAPACITOR articles have described specific circuits and instruments employing transistors or diodes.

OTHER SOURCES

1. "Properties and Uses of Thermistors — Thermally-Sensitive Resistors," J. A. Becker, C. B. Green, and G. L. Pearson, ELECTRICAL ENGINEERING, November, 1946.
2. "Improved Method for Measuring Hall Coefficients," I. Isenberg, B. R. Russell, and R. F. Green, REVIEW OF SCIENTIFIC INSTRUMENTS, 19, 685, 1948.
3. "Applications for Thyrite Resistors," Rufus P. Turner, RADIO & TELEVISION NEWS, January, 1951.
4. "Voltage Sensitive Capacitors," ELECTRONIC DESIGN, July, 1954.
5. "Light Amplifier," ELECTRONIC DESIGN, November, 1955.
6. "Magnetoresistance — New Tool for Electrical Control Circuits," R. K. Willardson and A. C. Beer, ELECTRICAL MANUFACTURING, January, 1956.
7. "Design and Construction Features of a Nuclear-Powered Cell," ELECTRONIC EQUIPMENT, March, 1957.
8. "A Solid Electrolyte Battery," Burton F. Wagner, ELECTRONIC DESIGN, October 1, 1957.
9. "Where to Use the New Semiconductor Materials," Robert K. Willardson and Theodore S. Shilliday, MATERIALS IN DESIGN ENGINEERING, March, 1958.
10. "Using the Varicap, Voltage-Variable Capacitor," Rufus P. Turner, RADIO-ELECTRONICS, May, 1958.

This CORNELL - DUBILIER Advertising Service is FREE to "Capacitor" readers. If there is anything of general interest or appeal in the line of electronic equipment or service that you want to BUY — SELL — or SWAP . . . if you want a job or need help, these columns are at your service.

Please PRINT or TYPE your Ad clearly and limit it to 40 words including your name and address. Because of space limitations — only one Ad at a time — please.

Ads are published in the order received and as space permits.

CORNELL-DUBILIER ELECTRIC CORP. reserves the right to edit your Ad to conform to its policies and is the final judge of its suitability for publication. We do not assume any liability or responsibility for any transaction that results. Make your deal direct with the advertiser listed in the Ad.

If you have a "CHANGE OF ADDRESS" — give both your OLD and NEW and mark your request "For C-D Capacitor Mailing List."

IF YOU ARE RECEIVING DUPLICATE COPIES FOR WHICH YOU HAVE NO USE, PLEASE ADVISE YOUR LETTER CARRIER STATING — "DUPLICATE — NOT WANTED".

SELL OR SWAP — Pilotuner T-601a 88-108 mc.; Riders 8 and 9; Sams 93 and 277. All like new. John W. Lezinsky, 174 Blaine St., Fairfield, Conn.

SWAP — Export-import course, like new. Want scope or sweep sig. generator. J. F. Caldwell, P.O. Box 96, Marshall, Texas.

FOR SALE — Westinghouse UHF tuners, H-803-7, complete with new 6AF4 tube, can be adaptable, sacrifice $10 each. M. C. Bowman, Box 2269, Montgomery, Ala.

SELL OR TRADE — NRI 33 signal tracer with probes and manual, $30; 2-mercury switches 110 v., 50 amp., $1; HV transformer, pri 110 v., 100 watt, sec. 12 kv @ 21 ma., $7. All prepaid. Want tube tester or kit. Toll House, Box 46, West Cornwall, Conn.

WANTED — Like new 17YP4 pic. tube and used bar-bell set. Have DTI Radio and TV course, like new, for best offer. Leo Teply, Geddes, So. Dakota.

SELL OR TRADE — Cannon deluxe camera with telephoto lens, 135 mm. range finder, lens cover and case. Interested in xmitting equipment, commercial or good home brew. J. D. Morgan, Box 130, Greenwood, Miss.

FOR SALE — Surplus resistors, tubes, capacitors, transformers, very good cond., and completely checked. Send order, state price, if acceptable, will ship COD. D. Falk, 111 Clinton St., Wausau, Wis.

SWAP OR SELL — Electronic strobe photographic flash with two lights, storage batteries and AC charger; Heathkit scope, Kodak reflex and Robot cameras. Want electric guitar, tape recorder, Hi-Fi equip. Dave Siegel, 130-18 223rd St., Laurelton 13, N. Y.

WANTED — NRI course for reasonable price. John Kregzde, 2859 Francis Ave., Los Angeles 5, Calif.

WANTED — Navy ARC-5, T-21 transmitter, condition very good, 5.3 - 7 mc. Fred Franke, 262-03 Hillside Ave., Floral Park, N. Y.

FOR SALE — Neon sign transformers of various voltages, $5 up; Talk-A-Phone deluxe late-model intercoms, $25; Mallory 6-volt, 4 amp. battery charger, $5; Westinghouse motor relay starter; 3 hp 110 v., 5 hp 220 v., $7. Philip Li Calzi, Greenwich, N. J.

FOR SALE — Gonset G66B mobile rcvr with 3-way power supply, in very good cond., $180. Ptl. Edward Russell, 93-09 207th St., Queens Village 28, N. Y.

WANTED — Supreme 562 Audolyzer, must be in working condition. State price. W. B. Jones, Carnesville, Ga.

WANTED — Silvertone 6230 radio, battery operated, any condiiton. William Jarvis, 1214-5th Avenue, Beaver Falls, Pa.

SELL OR TRADE — 6-volt Windcharger generator for cash or small scope. E. Reeser, R. 2, Wichita 15, Kan.

WANTED — Tuning condensers from BC-454 rcvrs, complete with all gear and worm drive; also unmodified BC-453 and Tecraft 220 mc. xmtr. Joseph Szabat, 228 Plummer St., Oil City, Pa.

TRADE — Law course by American Extension, 140 lessons, almost new, for VTVM or VOM. E. Arsenault, Box 476, North Oxford, Mass.

FOR SALE — Like new Heathkit TS-1A TV alignment gen., $25; Sylvania VHF-UHF color TV, 15" tube, $150. Raucher, 5101 Morley Dr., Greendale, Wis.

FOR SALE — BC-645 xmtr-receiver with tubes in factory carton, includes PE 101C dynamotor, control box, shock mount, and conversion manual. Chuck Williams Radio & TV, 12238 Promenade, Detroit 13, Mich.

SELL OR SWAP — National electric cash register, has automatic roll paper cash slips, $100, or swap for tape recorder or test equip. Control Radio and TV Service, 123 Avenue U, Brooklyn 23, N.Y.

FOR SALE — Radio magazines, 1922-1929, $7; like new: fifty 39/44 tubes, $10; mahogany case for Fisher FM 90 tuner, $10; 7½" 200 micro-amp. meter VTVM scale, $10. All FOB. F. Denning, 86-75 Midland Pkwy., Jamaica 32, N. Y.

FOR SALE — Rek-O-Kut: 16" G-2 deluxe turntable, $95; M-5S lathe, 8-ohm and 500-ohm cutters, $145; recording amplifier R-8A, $85; Shure 55S mike, $35. All in very good condition. Gil Sanford, 8803 Littlewood Rd., Baltimore 34, Md.

FOR SALE — TV RCA 8TS30 with magnifier, $15; 75 radio tubes in orig. boxes, 66% off list. Max Adler, 1027 Walton Ave., Bronx 52, N. Y.

FOR SALE — Converted mahogany Victrola Lowboy with 12" Jensen coaxial reproducer; 3¼ x 4¼ Graphic camera 4.7 coated lens, RF flash gun, case and 10 holders, like new. Make offer. G. L. Appleyard, 7 Woodcliffe Rd., Lexington 73, Mass.

WANTED — Receivers: S-20R, SX-24 and 25, HQ-120, etc.; modulation transformer vari-match for KW. State condition and price. D. F. Phillips, 49 East Grandview Ave., Sellersville, Pa.

SWAP — Gonset 3030 Super Six converter. Want Double Stator transmitting condenser — preferably HFBD 65-D, TVL coils, jack bar, or what have you? A. Bell, Slickville, Pa.

SELL OR SWAP — Heath TS-3 sweep-marker generator in very good cond., with instruction manual, crystal, and cables. $20. or what do you have? C. B. Davis, 1296 Brookforest Dr., N.E., Atlanta 5, Ga.

WANTED to Buy, Borrow, or Rent — CTI Air Conditioning and Refrigeration course without kits. Lloyd J. Tipton, Rt. 1, Box 255, Relief, N. C.

FOR SALE — Pilot 120 TV chassis only, no tubes, with FM radio $12; 2 Delco auto radios with built-in speakers $8 each; Delco refrig. motor, DC, 120 v., 1/5 hp, like new, $10; 17" console Zenith TV chassis, no tubes, $17. Joseph Iadarola, 1677 Maple St., Fort Lee, N. J.

FOR SALE — Jerrold DSA-132 De-Snower, and unused DA-8 distribution amplifier; very good cond., guaranteed. Luckey's Radio and TV, Box 666, Burns, Ore.

FOR SALE — UHF converter, DuMont $12; Superior CA-11 signal tracer $10; Ferret substitution speaker and condenser box $6.50. Charles Glaser, 59 Thompson St., Raritan, N. J.

SELL — General Industries R90L deluxe, dual-speed 33⅓ and 78 rpm disk recorder and playback in good condition, $20 plus shipping. George Gnandt, R. 2, Wellington, Ohio.

FOR SALE — Eico HFT-90 FM tuner, with cover, in very good cond., wired hardly used, $45. Buyer to pick up. Charles DeSimone, 262 North 6th St., Brooklyn 11, N. Y.

FOR SALE — Like new mobile transmitter 10/11 meters, $15; noise clipper, $3, and modulator 25 watts, $10; Eico VTVM $18; Eldico antenna-scope, $20. Ronald Newland, 206 So. Highwood Ave., Glen Rock, N. J.

SELL OR TRADE — 773 Weston tube checker, Jewell 4 meter analyzer, 0-2 ma Weston 301 meter. Want rifle, scope, or binoculars. Harry Ferris, 5604 Nottingham, St. Louis 9, Mo.

SELL OR TADE — Supreme 565 VTVM, Superior 650A sig gen., assortment of resistors and conds., books on Radio-TV fundamentals, few CQs - QSTs '47 - '49. Want small bore handgun, certain tubes. Richard W. Freligh, Box 322, Barnesville, Ohio.

WANTED — Hallicrafters SX42, 43 or 62 and S102. Evan H. Boden, R.D. 2, Emporium, Pa.

FOR SALE — CIRE communications, National electronics, and Sams TV courses, all three for $25; Precision E-200 sig. gen., $30; Eico 352 bar gen., $10; Heath IB2 imp. bridge, $40; B&K 400/leads, $40. F. Witmer, G-4 Sig. Hq., USATCA, Ft. Knox, Ky.

SELL OR TRADE — Sprague TO-5 teleohmike $60; Heath "Q" meter $30; NRI model 11 VTVM $20. Want Hallicrafters SX-25 and S-39, 1920 goose neck horn speakers, Radio News from 1919 to 1925, diamond needle for Edison Amborola. C. Wegrzynowski, 51 No. Central St., Buffalo 12, N. Y.

FOR SALE — Hallicrafters S20R comm. receiver $40; VOM Simpson 260 in roll top case, like new $35; WRL 6 meter SWE bridge and output indicator $10; 2 Ward disguise mounts and 6 meter whips $10 per set. T. S. Grove, Box 206, Montrose, Pa.

FOR SALE — Atwater-Kent Bread Board in pool cabinet; Riders Radio manuals 1-14 — Radiola-25 — Eagle Neutrodyne — "Service" from Vol. 1 — old magazines — prewar tubes. George Eddy, 35 Madison Ave., Madison, N. J.

FOR SALE — 45 assorted Centralab controls, $4 for the lot, prepaid; old type tubes and parts; Bronson 400 spinning reel, $5 prepaid. R. L. Turner, 2019 Sherman St., Anderson, Ind.

WANTED — Command set, 550 - 1500 kc broadcast band receiver, with or without dynamotor. Advise price and cond. A. L. Oliveira, 94 Potomska St., New Bedford, Mass.

FOR SALE — Rider radio manuals 1 to 13 incl., in good cond., $50 FOB; 630 TV rec. (Crosley 307) 10" pic tube, in working cond., $25, prefer local sale. C. F. McCracken, 255 Foulkrod Blvd., King of Prussia, Pa.

FOR SALE — Unused Eico HFT-90 FM tuner, complete with enclosure, wired completely, audio and multiplex outputs, $42 delivered. T. H. Mackintosh, Elon College, N. C.

SELL OR TRADE — 4 wall-type crank telephones with gen. for ringing $7.50 FOB; like new late model Heath sweep-marker gen; receiving and transmitting tubes. Want Heath DX-20 and GD1-B grid dipper. McHargue Radio & TV Service, Princeton, Mo.

FOR SALE — Hallicrafter S40A four-band AC 9-tube receiver, $60. Sent express collect. Henry Altmann, 37-14 72nd St., Jackson Heights 72, N. Y.

SWAP OR SELL — Electric mandolin outfit. Want 17" TV or 7 transistor portable radio. Ray Green, Box 50, Milford, Mass.

POSITION WANTED — Electronics technical writer-photographer-technician, four years' experience, desires a position on West Coast. Graduate USAF electronic schools and correspondence school. Work appears in many electronic magazines. John A. Comstock, Rt. 6, Box 41, Wellsboro, Pa.

FOR SALE — Precision E-200C sig. gen., instructions, $65; empty 7" tape reels and boxes, 25 cents each; tape book $3; 16 mm spools for camera, 5 cents each; GE 3-way portable radio, $25 FOB. All very good cond. J. Locascio, 8561 66th Road, Forest Hills 74, N. Y.

FOR SALE — 0-10 Heath scope, less probes $70; Mallory vibrator tester 6VT1 factory wired $20; B-K 500 tube tester with extra adaptors $85; Heath condenser checker C-3 $12; Alliance booster AB-5 $10. All in good condition. F. Berry, 4623 Eventide. Kalamazoo, Mich.

SWAP OR SELL — 10 TV sets including 2 - 21" consoles, as is, $100, or swap for Polaroid camera, scope, or tape recorder. No delivery. V. De Leon, R. 2, East Chatham, N. Y.

FOR SALE — Precision 117B scintillation counter, absolutely like new, has six sensitivity ranges, time constant switch, radioactive calibration source, leather carrying case, $80, or trade for equal value scope. W. E. Witte, 7700 East 108th St., Hickman Mills, 34, Mo.

FOR SALE — Riders Radio Troubleshooters manuals 1 to 5, abridged 6 thru 17, and TV manual, $65, guaranteed like new, plus textbooks and technical magazines from 1949 to date. Frank Zablocki, 108-24 Inwood St., Jamaica 35, N. Y.

SELL OR TRADE — Stancor 69 xmtr with all coils for 80-40-20-10 meters; 50 watt CW, 40 watt phone, $30, or need VTVM, grid dip meter, or ?? J. A. Zachritz, 1833 Cedar St., Hayward, Calif.

FOR SALE — UTC voltage adjuster R-81, input 60-140 v. in, 115 v. out, 1200 watts, $20; Shure 55A low imp. mike, $10; RCA voltohmyst 195A with diode and hi-voltage probes, good, $25. John F. Mitchell, Rt. 3, Bristol, Va.

WANTED — C24283-DX-Radio 1-10 yoke for Arvin model 2160-CH-TE-290. State price. Space TV Service, 131 Stratford Drive, Houghton Lake 12, Mich.

FOR SALE — Several hundred resistors, 20 good tubes, condensers, PM speaker, IF xformers, knobs, parts, hardware, $12 postpaid. John H. Ellis, Volunteer Bay, Vermilion, Ohio.

FOR SALE — Superior TV-50 genometer, like new, $35; Aline-A-Pack, $5; Antenna lead checker, $12; speaker and output trans. substitution checker, $20; NRI multitester with AC head. Make offer. B. J. Plunket, Jr., 1610-21 Ave., Altoona, Pa.

TRADE — Navy PT-19 ARC-4 two meter transceiver with tech. manual less dynamotor, for National SW-54 or equiv. Harold Webster, 208 "F" Street N.W., Bentonville, Ark.

FOR SALE — Sound-truck: 6 amplifiers 10 to 60 watts, 4 - 12" inside speakers with baffles, 4 outside University 30" re-entrance horns, 5 - 25 watt drivers, mikes, cables, DC to AC inverter, phono motors, etc. Complete or part. Michael Desesa, 712 Broadway, Everett 49, Mass.

WANTED — Branch factory designation, specialist in TV, Hi-Fi, and radio repairs, established 11 years in New York City, now moved to Puerto Rico. Ram TV Service, 19 San Vicente St., Mayaguez, Puerto Rico.

FOR SALE — Rek-O-Kut T-43-H 12" turntable, 33 and 45 rpm, hysteresis motor, $25; Nortronics SK-100 stereo conversion kit, in orig. box, $16; GE A1-500 12" pickup arm, rewired for stereo, $8 FOB. Jack Atkins, 1375 27th St., Ogden, Utah.

SELL OR TRADE — RCA WO-88a scope; Radion UHF meter; 6 v. battery eliminator; Heath vibrator checker; 3 RCA Pictoguides; 97 Sams Photofacts between 9 and 377 plus 10 binders. Want guns or cash. Fred Pointer, 2615 Westminster, Peoria, Ill.

FOR SALE — Knight tube tester, very good cond., modernized with 16 filament voltages, new roll chart, latest testing data, instruction manuals, $25, plus shipping. Bill Kubik, R. 2, Kaw City, Okla.

WANTED — Monroe calculator; planimeter; set of ships curves and other drafting materials. Will swap ham gear, etc. Barker, Woodside Dr., Freeport, Ill.

SELL OR TRADE — Portable 78 rpm auto. changer, Riders Radio manuals, 12" Philco TV. Jim's and Gene's TV, 33 No. Grape St., Mt. Carmel, Pa.

SELL OR TRADE — Bergen 812 8-pc. drawing set, 4-125A tube, Knight R-F-Z bridge. Rev. H. Francis Berkshire, 2102 No. 68th Pl., Scottsdale, Ariz.

FOR SALE — B&K 1000 dyna-scan picture and pattern generator with built-in audio and color bar generator, like new in orig. carton, only $145. Thomas M. Burke, 116 Tarlton Rd., Utica, N. Y.

SELL — Top quality like new radio-TV test equipment: NC-88 rcvr, 540 kc to 31 mc, BC-375 trans. in orig. carton, Mark 2 transceiver, German port. long and SW receiver; Leica, Rolleiflex, Bolex cameras, like new. S. Miller, 1104 Hellerman St., Philadelphia 11, Pa.

FOR SALE — DX-35 xmitter and Heathkit VFO in very good cond., ready for air, $50. Allan Gunn, 190 Washington Ave., Beacon, N. Y.

FOR SALE — C-D "Capacitor" — complete sets for 1953, 1955, 1956, 1957—11 issues, 1958—10 issues, miscellaneous 1952 and 1954. All $5. Libby, 126 Bennett St., Port Richmond, Staten Island, N. Y.

FOR SALE — Hallicrafters SX-99 in very good cond., $125, or will consider trade on light plane needing rebuilding. Edward L. Miller, Box 144, Calistoga, Calif.

SWAP — Columbia and Airline tape recorders, for Sams folders. Electronic Service Co., Box 56, Lexington Park, Md.

WANTED — Disc recorder in very good cond. State lowest cash price delivered. Larry Preston, 95-24 129th St., Richmond Hill 19, N. Y.

FOR SALE — All types of older radio tubes in orig. cartons; UHF converters; Fisher M scope, like new; 2 unused Tak-A-Fone intercoms. C. G. Hailey, Box 1146, Robstown, Texas.

FOR SALE — Gothard converter 115 DC to 115 AC, single phase, 500 watts continuous duty, extra set ball bearings, and extra brushes, fully filtered, like new, $50 plus shipping. Edward B. Schofield, 30 Lee St., Woodstown, N. J.

WANTED — Any size PM speakers for rebuilding. J. W. Jackson, 4704 N.E. 89th, Portland, Ore.

SELL OR TRADE — Approved A-465 field strength meter; Sams Vols. 1-34; Hickok 650C; Meissner analyst; wire recorder; Eico flybacker; large stock tubes, parts. Want audio test equip. Don Anglin, 7323 Ivory Way, Orlando, Fla.

WANTED For Cash — Kwik Test condenser checker, also 400 watt or heavier soldering iron. Top Refrigeration Service, 7888 N.E. 1st Ave., Miami, Fla.

FOR SALE — Hickok: 600A tube tester, 565 wide band 5" scope, 601A sweep gen, 203 VTVM, 156 traceometer; Sprague TO-3 Tel-O-Mike; Jackson TVG-1 sweep gen; variable voltage xmfr. All like new cond. Make offer. J. Wilson, 1687 Daley Rd., Lapeer, Mich.

FOR SALE — Motorola auto radios, still in boxes, never used, one push-button, one manual. S. S. Canfield, 1430 East 55th, Cleveland 3, Ohio.

WANTED — Pilot 3" TV sets, model TV-37U. Any condition acceptable. Schauer Radio & TV Service, RR 2, Paw Paw, Mich.

WANTED — RME VHF 2-11 compact or RME 152-A converter. Have SX-71 rcvr, amplifiers from 40 to 75 watts output, cone speakers, driver units, horn baffles, etc. John Arnold, Wilson St., Bluffs 3, Ill.

SELL OR TRADE — Like new WR-36-A RCA dot bar gen.; Rimco dynalyzer; Simpson 476 mirroscope; Dumont 208-B scope; and Approved A-460 field strength meter. Need Altec Lansing 604-C and/or large size lens or mirror for astro telescope. Gil Howarth, 216 1st Ave., East, Oskaloosa, Iowa.

WANTED — RME-99 comm. rec. for cash, or trade Meissner TRF Hi-Fi tuner, model 4E; Browning AM-FM tuner, model RJ-12. J. Phennicie, Jr., 1505 - 14th Ave., S.W., Cedar Rapids, Iowa.

SELL OR TRADE — NRI Radio-TV home study course and multitester, $25, or trade for 6 and 12 volt battery eliminator-charger. Glenn Crise, RD 1, Box 140, Smithton, Pa.

FOR SALE — Hickok 610A sweep gen.; Hickok 680 crystal calibrator, very good condition. Sacrifice. M. T. Brittingham, Morehead City, N. C.

WANTED — Sweep generator, such as Sylvania 500, Precision 400A, RCA WR-59B. Must be perf. working order. Will pay to $65. Have Heath 0-9 scope, perf., $40, or will swap. Latham Radio & TV, Cuba City, Wis.

WANTED — Oak Ridge 103 signal gen., with operating manual. William Sharkey, 42-66 Phlox Pl., Flushing 55, N. Y.

FOR SALE — Stancor 752 battery eliminator, 6 - 12 volts, 12.5-25 amp., $30 plus freight. Robert Gorseline, 9406 Seminole St., Silver Spring, Md.

WANTED — BC-639 tunable VHF receiver, 100-156 mc, with AC power supply RA-42. State price and cond. R. W. O'Brien, 1534 South Ave., Syracuse 7, N. Y.

FOR SALE — Hallicrafters SX-71 comm. receiver, good cond. Best price. Jerry Birnbaum, c/o J. Finklestein, 940 Simpson St., Bronx 59, N. Y.

FOR SALE — Motorola 150 watt AM phone xmitter, $100; Elmac PS-2v power supply, $35; Riders Encyclopedia on Cathode Ray Oscilloscopes and Their Uses, $5; 2-meter 6 w. phone xmitter and receiver, $50. Robert D. Bradley, 1002 Forest Rd., LaGrange Park, Ill.

WANT — TV repair course without kits. State price. L. Schneider, 70 East Main St., Bergenfield, N. J.

WANTED — 3" Heathkit scope. R. F. Chambers, 13833 San Antonio Dr., Norwalk, Calif.

SELL OR TRADE — Timex recorder with over 24 plain discs; Zenith table model TV, A-1 cond. George's Radio Repair, 3317 East St., N.S. Pittsburgh 14, Pa.

SELL OR TRADE — Vornado B200 2-ton central air conditioner, 220 v. AC, $325, or trade for good ham receiver. Wilbur Hait, 1220 Oakwood Rd., Haddonfield, N. J.

URGENTLY NEEDED — Buy, borrow, or rent schematic for Supreme 599 tube checker. Especially need manufacturer and model number of tube checker transformer contained therein. Don Wasserman, 102-H Brookside Ave., New Haven, Conn.

SELL — Best offers, possibly trade: 1-10A, all coils; MAR 10-channel autotune 225-390 mc AM xmtr - rcvr; TBS 6M 150 w. xmtr, complete plus spares; 16" disc recorder, 2-speed, cuts in or out. Robert Townsley, 5939 Almaden, Oakland, Calif.

FOR SALE — All Heath: O-9 scope, perfect; TS-2 sweep and marker generator; VC-2 or scope calibrator. All three for $40, or sell separately. Paul E. Brugger, Cuba City, Wis.

FOR SALE — Riders Vols. 1-19 in good condition. Make offer. Southern Radio-TV, 124 E. Jackson St., Thomasville, Ga.

WANTED — 304TL and other high plate dissipation tubes. Ted Dames, 64 Grand Place, Arlington, N. J.

SELL OR TRADE — Radio and electronic parts, sub-assemblies, xfmrs, tubes, resistors, speakers. Need good receiver, power xfmr, xmtr tubes. W. I. Barry, 1229 Edgehill Rd., Darby, Pa.

SELL OR SWAP — RCA color TV CT-100 like new; RCA Institute Home Study Color TV course. Want cash, sweep and marker generator, 5" scope, or tube tester. Devaney, 631 South 60th Street, Philadelphia 43, Pa.

FOR SALE — Hallicrafter SX-105, used very little, 150 mc to 174 mc FM, $70. Art Bonte, 3138 Kingsbridge Terr., Bronx 63, N. Y.

WANTED — KWS-1, KWM-1, 2-meter communicator; KW Matchbox. Have for trade Viking II, 75A1, 12" Jensen spkr., VM changer, PE103, 872, 304L. K. Miller, 14979 La Cumbre Dr., Pacific Palisades, Calif.

FOR SALE — DX-35 and VF-1, very reasonable. Will ship upon receipt of money order for $60 plus freight charges. Need Johnson 275 w. Matchbox. J. Coffield, 1721 W. First St., Brooklyn 23, N. Y.

WANTED — Howard or RME Preselector. State cond., price, model. Howard A. Keever, 1501 Glorietta NE, Albuquerque, N. M.

FOR SALE — Western Elec. network and impedance matching xformers, 12 terminals, with schematic printed on case, originally cost govt. $11.20, only $1 postage paid. Communication Sales and Service, 1645 Oregon Ave., Steubenville 1, Ohio.

FOR SALE — Several hundred like new obsolete tubes, 50% off list. W. W. Wehr, 523 Parson St., Easton, Pa.

SELL OR TRADE — Full Sprayberry course in radio and TV, no kits. Need good working scope. Edmund Owsiany, Box 359, R. 2, Leechburg, Pa.

FOR SALE — Heath 1B-1B impedance bridge, with hummer and manual, like new, $55 plus postage. Lawrence Lechtreck, R. 1, Box 16, Creve Coeur, Mo.

FOR SALE — Eico 315 sig. gen., $25; Arkay AM-FM tuner HFT-7, $25; Eico 232 VTVM, $30. John P. McCullen, 3050 Bainbridge Ave., Bronx 67, N. Y.

FOR SALE — Unused Simpson 406 Chromatic Amplifier, $11 plus postage. Langel's TV and Radio, 49 Warner St., Plains, Pa.

WANTED — Gonset III 6-meter transmitter, must be in A-1 condition. State price. H. Fistel, 1635 E. 10th St., Brooklyn, N. Y.

SELL OR TRADE — Enclosed instrument or relay rack for 3 panels 10½ x 19, slant front with 4 outlets front and back, 30 lbs., $10 FOB, or trade for 3-speed man. or auto. record player. Sahr Radio, Fairmont, Minn.

WANT — Parts or good H.P. rig. John Seaman, W. Macada Rd., RD 2, Bethlehem, Pa.

WANTED — Old used files, any quantity, for cash. C. Ahart, 38 Pine Street, Spotswood, N. J.

FOR SALE — Heath condenser checker and RF sig. gen; Chicago VTVM; Industrial Institute Radio and TV course. Edward Morawski, 8640 Warren Blvd., Centerline, Mich.

FOR SALE — 10 henry choke 250 ma, $3; 4 henry choke, 300 ma, $2.75; 6 v. 10A filament transformer, $3.25; Stancor A-4351 input transfermer, $3.25; 24 v. 10A transformer, $7. Michael Bilgrei, 146 Hewes St., Brooklyn 11, N. Y.

FOR SALE — Stancor 110C, 100 w. Fone-CW all-band xmitter includes all power supplies, VFO; NRI 69 tube tester; AT-1 booster. Make offer. Newell's TV-Radio Service, RD 3, Franklin, Pa.

WANTED — "Television Servicing" by W. Bauschbaum, 2nd edition; "UHF Principles and Practice," by Alan Lytel. Must be reasonable and good condition. D. McCarthy, 32 Chatham St., Hartford, Conn.

FOR SALE — University extended range 8" speaker, $15, and 308 triaxial 8" speaker, $25; Electro-Voice extended range 8" speaker, $17. In factory sealed cartons. Will trade for amplifier or record changer. Carmen Nieves, 642 Fox St., Bronx 55, N. Y.

TRADE — Gonset 30-40 tuner and companion power supply, like new, for 6-meter gear. Charlies' Radio, 81 Warren St., Roxbury 19, Mass.

FOR SALE — Electro model P eliminator, $10; Superior TD-55 tube tester, $25; model 101-C tube checker, $5. Want 8 mm movie projector, must be reasonable. Martin Strawn, 610 King St., Lancaster, Ohio.

FOR SALE — Sams Photofacts, 50 thru 242, 80 cents plus postage; desk type receipt machine with receipts, $5 plus postage. Peter Kamarchik, Box 46, Madison, Pa.

FOR SALE — McIntosh 50 watt, 50 lb., Hi-Fi amplifier, in very good cond. No reasonable offer refused. R. N. Brunt, 61 South Spring St., Elizabeth 4, N. J.

TRADE — CREI Radio and TV courses, for Hi-Fi equipment, output trans, tuner, speaker, etc. J. Bazewick, 11221 N.E. 9 Ct., Miami 38, Fla.

SELL OR TRADE — Precise VTVM and Precise IIIK tube tester. Trade for rifle, binoculars, hunting bow and arrows, etc. Robert A. Mensel, 20 Brenner Pl., Demarest, N. J.

WANTED — RCA #WR-39B or later model crystal calibrator, also E-200-C Precision Generator. Both in good condition. D. McGlinn, 434 Carsonia Av., Reading, Pa.

FOR SALE — Riders Manuals 1 to 5 Abridged, 6 to 16, in very good condition. #0-5 Heathkit 5" scope and TS-2 T. V. Alignment Generator in good working condition — Best Offer. Bert Polfus, R3, Polfus Dr., Benton Harbor, Mich.

FOR SALE — Super — Pro Receiver. BC 1004 and Power Supply 160-80-40-20-Broadcast Band $88. S. Kramer, 2851 Sedgwick Av., Bronx 68, N. Y.

FOR SALE — Century 103 CRT Testavator with instructions $15.; Sprague TO-3 Tel-Ohmite, $25. with instructions.; Sams folders 60c. C. L. Demis, Walton, N. Y.

SELL — Full size 20 meter beam, single 813 transmitter, S-49 power supply, 3000 vdc capacitors, 4mfd bearing, 810, 826 sockets, 50w transmitter. W. E. Jones, Box 4, Bowmansville, N. Y.

WANTED — Gonset Super 6 converter; 15-20w 10 meter mobile xmitter; 6v units. State price, condition, etc. Richard T. Wicks, 85 Thoburn St., Johnstown, Pa.

FOR SALE — Riders 6, 8, 10, 11, 12, 14, $5 each; Zenith Service manual Vol. 1 and 2 (one cover) $5; Ghirardi Trouble-shooting manual, $3. All or single plus COD postage. Stephen Barniak, 2426 Perot St., Philadelphia 30, Pa.

FOR SALE — Riders Manuals 1 to 5 inclusive in 1 volume, 4 to 21 inclusive $200. Very good condition. Duke's T.V., 533 Monogahela Ave., Glassport, Pa.

SELL OR SWAP — Globe Scout 680 factory wired xmitter 80-6 meters, perfect $70., SCR-522 and ART-13 schematics 50c, tech manuals $1. Send for list. S. Consalvo, 4905 Roanne Dr., Washington 21, D.C.

FOR SALE — Electronic designs VTVM Model 100, $15. McMurdo-Silver 905 Sig. tracer $15. Kodak E 16mm. movie camera with case $12. All in very good condition. Joseph Golab, 175 Hopkins Ave., Jersey City 6, N. J.

FOR SALE — table model radios, 1/4hp motors, 16 mm sound films; E Kodascope silent 16 mm projector; Victor 16 mm sound projector, mic and phono inputs, sound and silent speeds. Calderaro, Main St., Wakefield, Mass.

FOR SALE — Practical Wireless Telegraphy by Bucher, 1917, good binding, $6. Radio Telephony, Goldsmith, 1918, fair binding, $4. Curtis, 1919 W. Kings Hwy., San Antonio 1, Tex.

WANTED TO BUY — Glass dial scale, or photostat of dial scale for Sparton receiver model 10 series. Wesley W. Harris, Rt. 5, Box 2325, Bremerton, Wash.

WANTED — AC Generator 110v, 1.5-2KV Cash or trade for, you name it. Bruno Price, 1173-76St., Brooklyn 28, N. Y.

FOR SALE — Hickok 203 vacuum tube VOM in very good condition, recently calibrated with leads and manuals. $35. Le Roy Singer, 4 Atwood Rd., Plainview, N. Y.

FOR SALE — Panadaptor SP44; VHF 152; CE Slicer; Electronic key; 2" scope; Brush crystal under-pillow speakers; National PW drive: XEC and Heath VFO's; misc surplus parts & tubes. F. D. Borman, 19491 Lowell Dr., Detroit 3, Mich.

SWAP — 1958 Encyclopaedia Britannica 24 vol. plus World Atlas and bookcase. unused, against Riders Radio and T.V. manuals or against professional test equipment in very good condition. W. D. D. Flym, 547 W-142 St., N.Y. 31, N. Y.

FOR SALE — AT-1 xmtr and AC-1 antenna coupler, modified 2E26 final gives 35w. A.C. Birnholz, 634 High St., Newark 2, N. J.

FOR SALE — Link 12v single case 30-44 mc FM xmitter-receiver unit, two frequency operation relays, with all tubes, xtals and tuning meter, $22.50. Colorscope Advertising Co., 1109 Pennsylvania Ave., Steubenville, Ohio.

WANTED — 3 tube Crosley Trirdyn battery radio with orginal xformers in same or diagram with turn ration. Newbern Radio Service, Rt. 2, 41, Brement, Ga.

SELL or TRADE — Lorcn APN-4 scope in good condition $10. fob. Want Heath or Knight general purpose scope in good condition also 16JP4-A tube. State price and condition. Thomas Kranyecz, 1235 Pembroke Rd., Bethlehem, Pa.

FOR SALE — Pair World War 2 German walkie talkies, xmitter and receivers. Working condition $25. for both plus postage. Wyatt TV Shop Rt. 5, Searcy, Arkansas.

SELL — Old radio tubes 24A, 45, 47, 26 etc., good condition. Want 5842/417A tubes also 6360 and 4X250B and 7JP4 in good condition. John Shaffer, 139 Stony Brook Dr., York, Pa.

FOR SALE — Machine Shop Training Course by Jones, new condition $9 COD. Stephen Barniak, 2426 Perot St., Phila 30, Pa.

WANTED — Capitol Radio Engineering course in Electronic Engineering Technology. Sell 800 cycle. 1000w aircraft generator 110v AC 24v 10 amps DC $25. Robert J. Reidy, 1307 Nelson Av., Bronx, 52, N. Y.

WANTED — Shortwave receiver National SW-3 with all coils, book, data, power supply and other gear that goes with it. State shape, etc., and price. Cash or trade. Al Ayling, 50 Palm Ave., Mill Valley, California.

SELL OR SWAP — Pierson KP-81 power-supply, amplifier, and speaker section, 2 unused 829Bs, 3E29 tubes. Want VTVM, 813s or 4-125s.Leonard Svidor, 3786 Muirfield Rd., Los Angeles 16, Calif.

FOR SALE — Weston 777 tube checker exc. with instruction manual and Paco T-60 tube checker with manual and latest charts. Best offer for both or either, local only. Charles Wollman, 90 Bank St., Valley Stream, N. Y.

WANTED — RCA Radiola Models 20 & 25 plus xtal set. John Diaz, 7411 W. Warnimont Ave., Milwaukee 19, Wis.

WANTED — Heathkit LP 2 linearity pattern generator. Raymond Dodge, 676 Verde Vista Ave., Pomona, Calif.

FOR SALE — RCA ATJ/CRV59 TV camera $99.; ATJ/CRV52 companion TV xmitter $30.; Heath FM-3A and BC-1A tuners professionally wired $28 each; ATR-RHF 6VDC to 110 VAC@125w. inverter $40.; SX-71 $175. All in excellent condition. Bob Schill, Box 412, Hinsdale, N. H.

WANTED — Ranger or DX 100 xmitter. Joe Coller, Jesup, Iowa.

SELL OR SWAP — Never used Weston 813 meter relay, 15 micro-amp. Joseph Eberson, 2116 Marris Ave., New York 25, N.Y.

FOR SALE — Instruction and Service manuals for AR-88 and CR 91 RCA receivers $2. Cash or money orders only. George Harrold, 1907 So. Park Ave., Haddon Heights, N. J.

FOR SALE — 1959 Realistic FM-AM tuner model T-1V, rated by mfg. at 2 microvolts for 30db quieting $50. J. R. Blundin, 214 W. 2 St., Mt. Carmel, Pa.

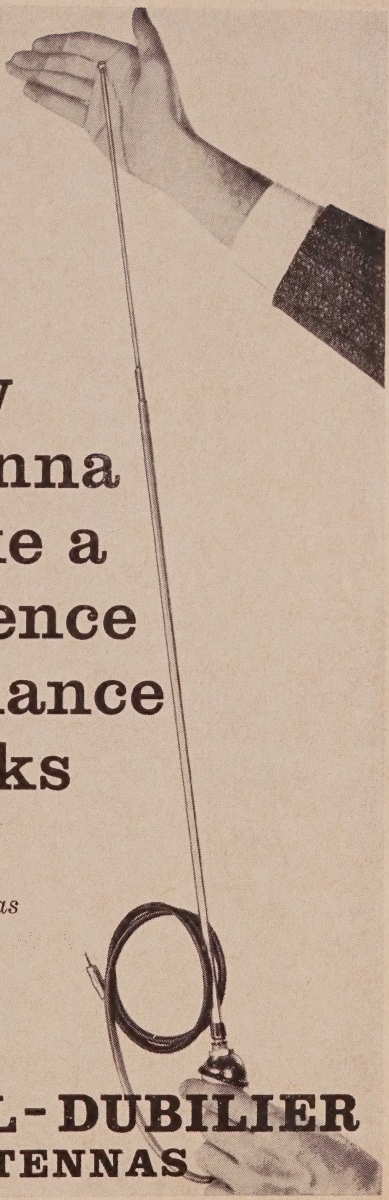
SELL — Highest quality British RCA FM tuner with 8 tubes, rectifier and two diodes $75. Leak arm with separate LP and 78 diamond stylus heads $30. All new condition. Postpaid. Kenneth Massey, 3449 Winthrop Ave., Indianapolis 5, Ind.

FOR SALE — Hickock 610 TV Alignment signal generator $60.; Video handbook $2.; Sams Photofact Volume; Admiral TV 1948-1953 $5.; RCA Color TV Pict-o-Guide $2.50. **WANTED** — C-D BF-60 or BF-70 C-R Bridge, or equal. O. Schwarz, 515 Huntington Ave., Plainfield, N. J.

SELL — Many years of Radio News, Service, Product Engineering, Electronics, Popular Electronics, Pop Science, Mechanix Illustrated, etc. or swap for radio or photo gear etc., or donate to worthy cause willing to pick up. M. Storch, 3605 Sedgwick Ave., Bronx 63, N. Y.

FOR SALE — 1949-50 Ford Radio and Kirby flyback and yoke tester for $35. or sell separately; slightly used Heath CRT Checker $20. Bill Collier, 1515-19th St. N.E., Roanoke, Va.

WANTED — Heathkit OL-1 3" scope. State price and condition. Al Lipkin, 6615 No. Uber St., Philadelphia 38, Pa.



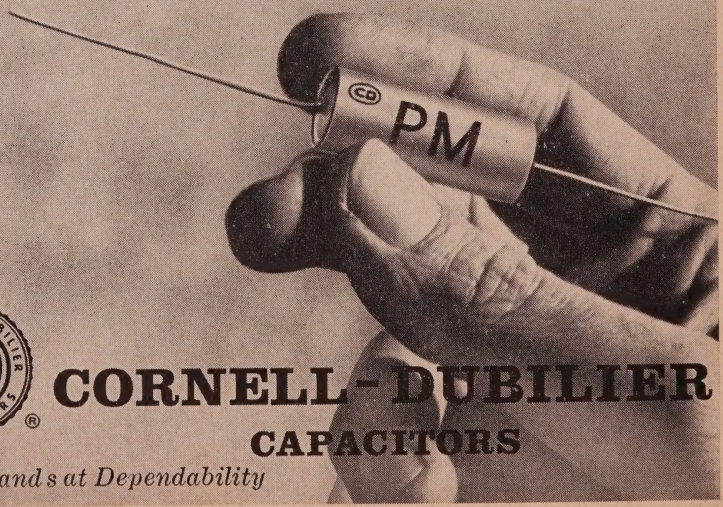
A new CDR antenna will make a big difference in performance and looks

See these new auto antennas at your CD distributor— or write for information.

CORNELL-DUBILIER ANTENNAS

*take the C-D type "PM" MYLAR tubular for instance . . . it's the last word in dielectrics. And C-D is first again with the best for service replacements.

to do the best job use the best*



CORNELL-DUBILIER
CAPACITORS
Old Hands at Dependability

Printed in U.S.A.